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Variation of water quality across Cooum river in Chennai city

Abraham Samuel*

Department of industrial Biotechnology, Bharath University, 173, Agharam Road, Selaiyur, Chennai 600073, Tamil Nadu, India
* E-mail of the corresponding author: abrahamsamuel@gmx.com

Abstract

The huge demand for freshwater resources in the 21st century can be attributed to population growth, advanced agricultural practices and industrial usages. This study attempts to evaluate the water quality of Cooum river across Chennai, and was carried out by systematic collection and analysis of 5 water samples from 5 regions. Samples collected at some parts of the city were even found to be not fit for irrigation as they had high acidity, low dissolved oxygen and high amount of dissolved solids. Some samples were also found to have certain microbes which pose health hazards when ingested. The major contaminant sources identified in the areas were the samples were polluted were liquid and solid wastes, discharges from factories and refineries, drainage of sewage, and brine water in estuaries.

Keywords: Cooum river, Water quality, Hydrochemistry, Aquatic microbiology, River management

1. Introduction

River water is used for domestic supply, industries and agriculture in most parts of the world as it is a replenishable resource and also is the main determiner of ground water level in a particular region. There has been a tremendous increase in the demand for freshwater due to population growth, advanced agricultural practices and industrial usages. Rapid growth of urban areas has affected the ground water quality due to over exploitation of resources and improper water disposal. However the quality of freshwater in an area is as important as the quantity of resources. Therefore there is always a need for concern and protection and management of water quality. Studies on water quality have helped in evolving a management plan in the Calcutta region of Bengal basin, India (Banerji 1983) . Handa (1986) studied the hydrogeochemical zones in a few places in India and indicated that the chemical composition of groundwater was affected by use of fertilizers. A similar study (Ramachandran S *et al.*1991) carried out in Madras basin also revealed the influence of agrochemicals on water quality of cultivated areas. This study attempts to evaluate the water quality of Cooum river within Chennai city with respect to domestic and irrigational purposes.

2. **Study Area**

The study area extends from the point of entry of Cooum river into Chennai city to the point were it exits into the Bay of Bengal. Also a sample from Adyar river is taken at Saidapet for comparison purposes.

3. **Sample collection and analysis**

The water samples were collected at 5 areas namely Nagalkeni (Sample II), Chembarambakkam (Sample II), Chetpet (Sample IV) , Chepauk (Sample V) on Cooum river for main analysis and at Saidapet (Sample III) on Adyar river for comparison purposes (Figure 1). TDS, pH, Dissolved Oxygen, and Microbial Flora of the samples were estimated using portable meters on site or at lab by using cultures. PH of the samples were calculated either on-site using pH strips or at labs using digital pH meters. Gram staining was also employed to differentiate the types of microbe present in the sample. Culturing the sample on selective media enabled the isolation of certain microbes.

4. **Methods Involved**

4.1 pH Calculation

pH was determined using pH strip onsite or at lab using pH meter.

4.2 Dissolved Oxygen Estimation

Dissolved oxygen was found using an oxygen sensor or a lambda sensor. Winklers Method was not used since Instrumental methods for measurement of dissolved oxygen have widely supplanted the routine use of the Winkler test, although the test was still used to check instrument calibration.

4.3 TDS Analysis

4.3.1 Organoleptic properties

The presence of dissolved solids in water may affect its taste (Bruvold WH *et al.*1969). The palatability of drinkingwater has been rated by panels of tasters in relation to its TDS level as follows: excellent, less than 300 mg/litre; good, between 300 and 600 mg/litre; fair, between 600 and 900 mg/litre; poor, between 900 and 1200 mg/litre; and unacceptable, greater than 1200 mg/litre (Sawyer CN *et al.*1967). Water with extremely low concentrations of TDS may also be unacceptable because of its flat, insipid taste.

4.3.2 Analytical methods

The method of determining TDS in water supplies most commonly used is the measurement of specific conductivity with a conductivity probe that detects the presence of ions in water. Conductivity measurements are converted into TDS values by means of a factor that varies with the type of water (International Organization for Standardization 1985, Singh T *et al.*1975). The practical quantitation limit for TDS in water by this method is 10 mg/litre (M. Forbes, personal communication, 1988). High TDS concentrations can also be measured gravimetrically, although volatile organic compounds are lost by this method (Sawyer CN *et al.*1967).The constituents of TDS can also be measured individually.

4.4 Differential Microbial Culture

To differentiate between lactose positive and lactose negative bacteria, the samples were inoculated in MacConkey agar. EMB agar was used in the detection of gram positive and gram negative bacterial colonies.

4.4.1 Eosin methylene blue agar

All the five samples were cultured in EMB agar media separately, and all the 5 cultures were found to have a distinctive metallic green sheen formed after 24hrs.

4.4.2 MacConkey agar

All the five samples were inoculated into 5 separate MacConkey agar media. Only pink colored colonies were found in all the 5 cultures

4.5 *Estimation of viable bacterial growth*

To estimate the amount of viable bacterial growth in each of the sample collected, the samples were inoculated in a non-selective media and growth of bacteria was observed.

4.5.1 Plate count agar

All the 5 samples were inoculated into 5 separate plate count agar media. All the cultures were found to have fairly a large number of viable bacterial colonies.

4.6 Differential Staining

In order to differentiate between gram positive and gram negative organisms obtained from the culture of the samples differential staining was performed.

4.6.1Gram staining

Purple colored spherical bacteria and pink colored rod shaped bacteria were observed under a simple microscope. In samples II, IV and V the purple spheres were found to occur in bunches while in III and IV it had presence of spheres occurring in chains.

5. Results and Discussion

5.1 General Hydrochemistry

5.1.1 PH

The pH of the water samples varied between 6.20 to 7.6 (Figure 2)

Sample I : 6.8
Sample II : 6.31
Sample III : 6.20
Sample IV : 6.28
Sample V : 7.6

5.1.2 TDS

TDS concentration varied from minimum1320 mg/l to maximum 5900 mg/l . The above results were mainly due to the discharge of polluted water into the river from leather factories and sewage water. Solid water disposal sites along the banks of Cooum river is also a main factor for the river being so polluted. The sample from saidapet too had high levels of TDS thus suggesting that the Adyar river too is no better than Cooum river. TDS of sample I is nominal. (Figure 3)

Sample I : 1320 mg/l
Sample II : 1984 mg/l
Sample III : 2652 mg/l
Sample IV : 2900 mg/l
Sample V : 5900 mg/l

5.2 Microbial quality

5.2.1 Dissolved Oxygen

Dissolved oxygen in Samples III, IV and V were found to be very low. (Figure 4)

Sample I : 9.1
Sample II : 5.8
Sample III : 3.5
Sample IV : 3
Sample V : 8.6

5.2.2 Microbial colonies

E.coli is the most common microbe found in all the 5 water samples.

All the organisms detected were lac positive.

Both gram positive and gram negative organisms were found.

Sample I : E.coli, Bacillus sp
Sample II : E,coli, Staphylococci sp
Sample III : E.coli, Streptococci sp
Sample IV : E.coli, Streptococci sp, Staphylococci sp
Sample V : E.coli, Staphylococci sp

Viable bacterial colonies in the samples were estimated by culturing on plate count agar. (Figure 5)

6. Inference

From the above results it can be inferred that water quality of river Cooum before entering Chennai city (Sample I) is good, but due to anthropogenic activities and discharges of industrial wastes and sewage into the river within the city, its water quality is at its worst and is unfit for domestic use as well as agriculture. Therefore effective management and treatment of this river is necessary in order to not lose a valuable water resource.

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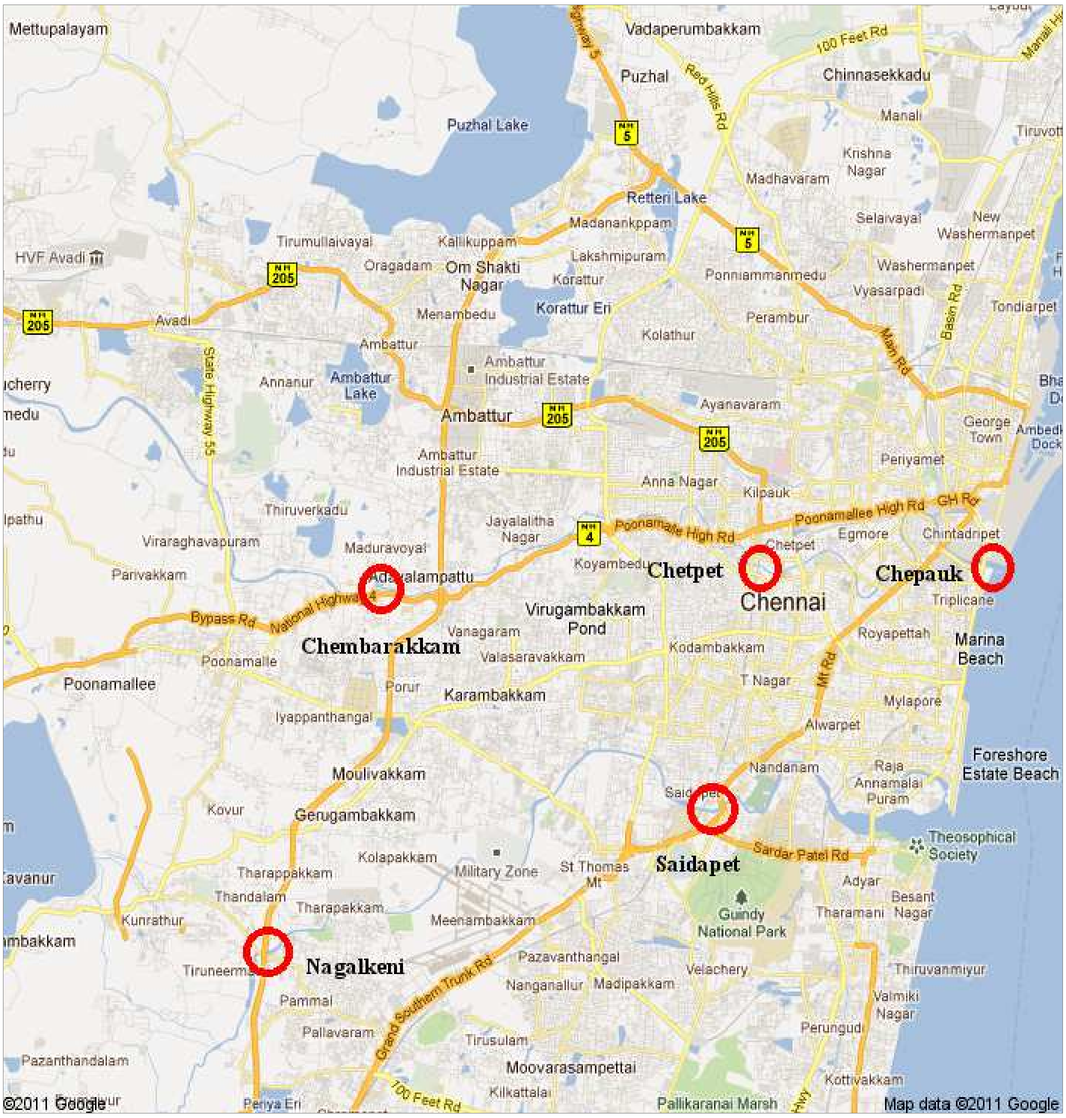

Figure 1: Sample collection areas

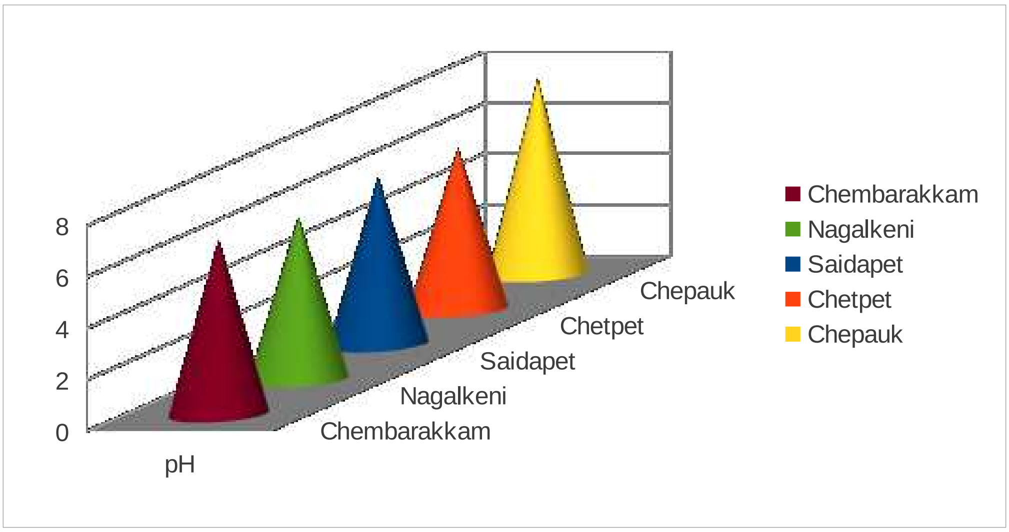

Figure 2: Variation of pH

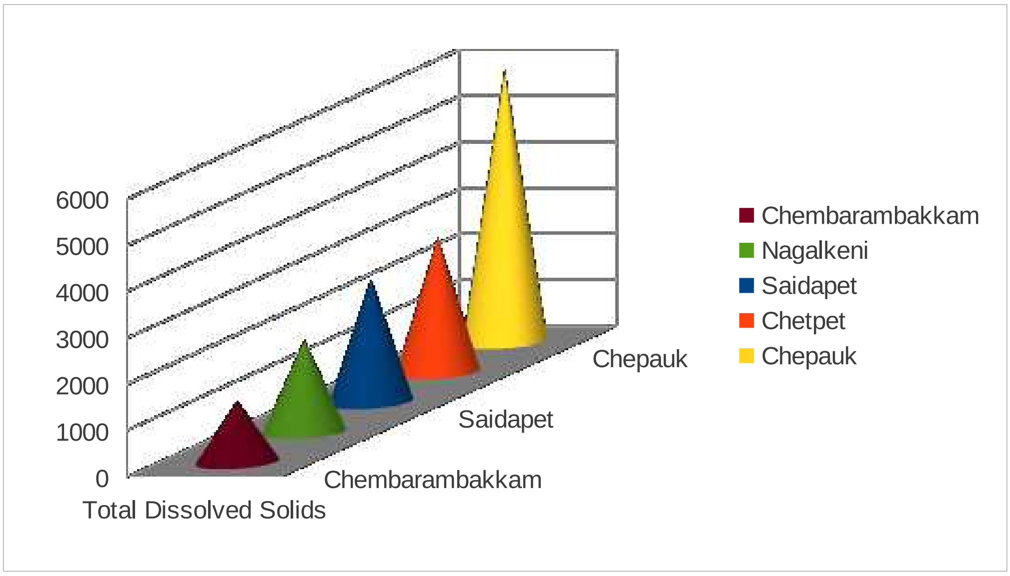

Figure 3: Variation of TDS

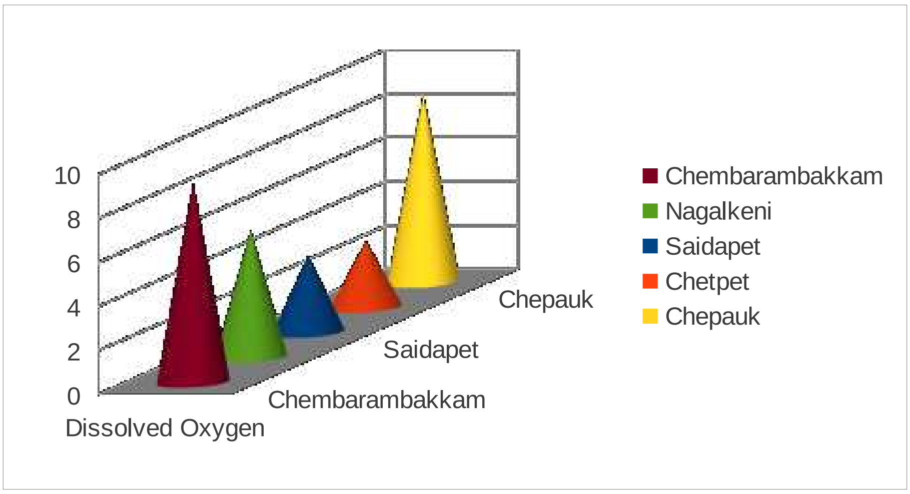

Figure 4: Variation of dissolved oxygen

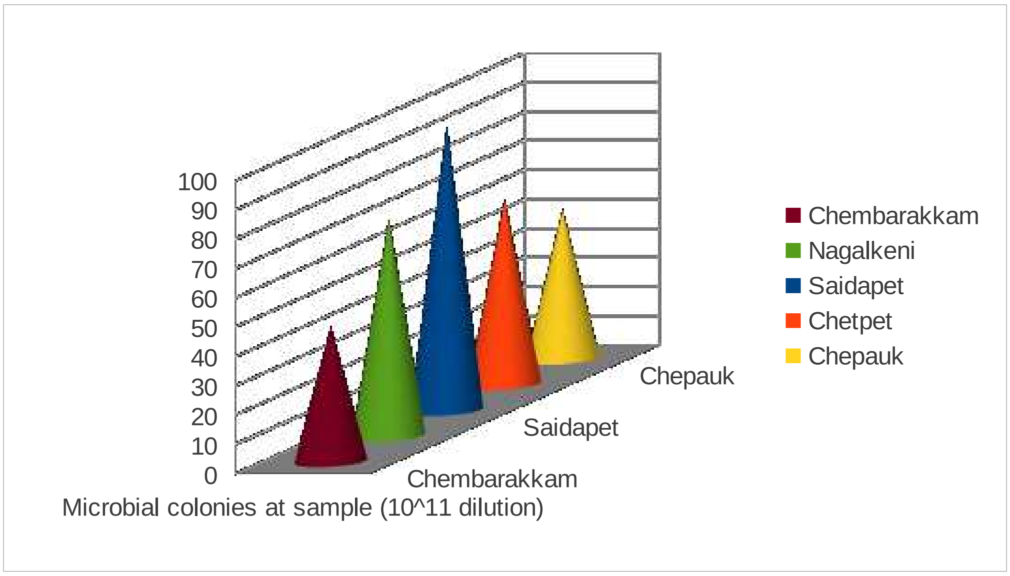

Figure 5: Variation of viable bacteria